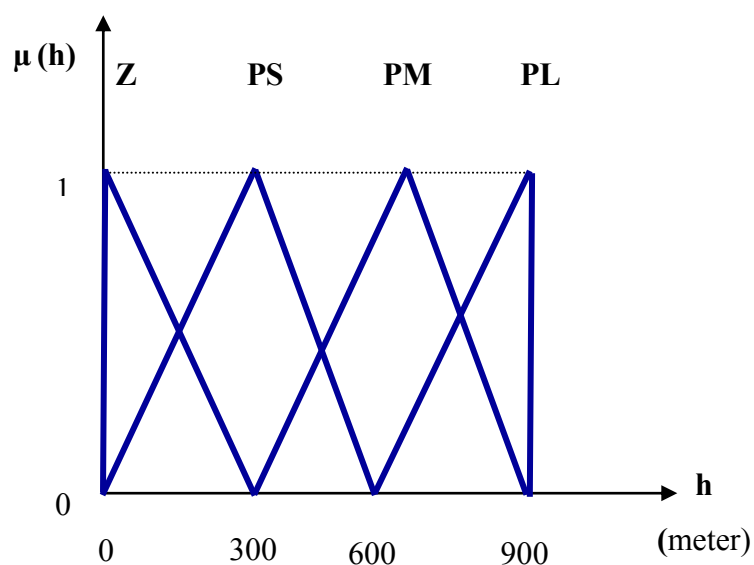


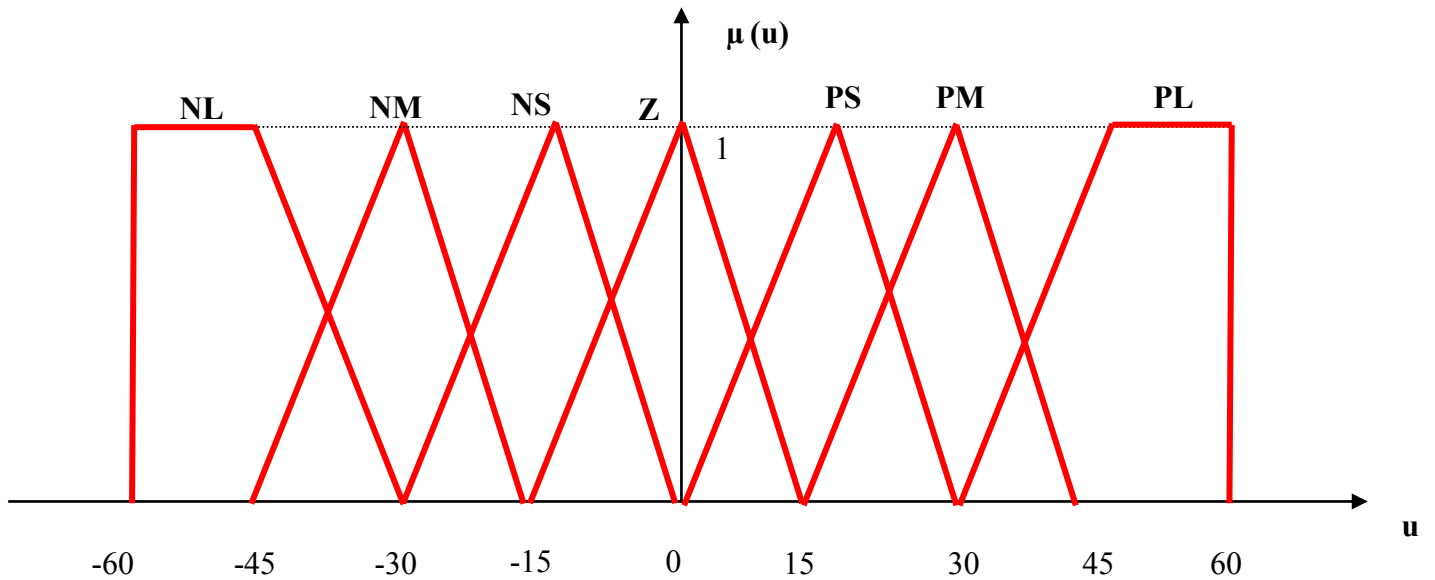
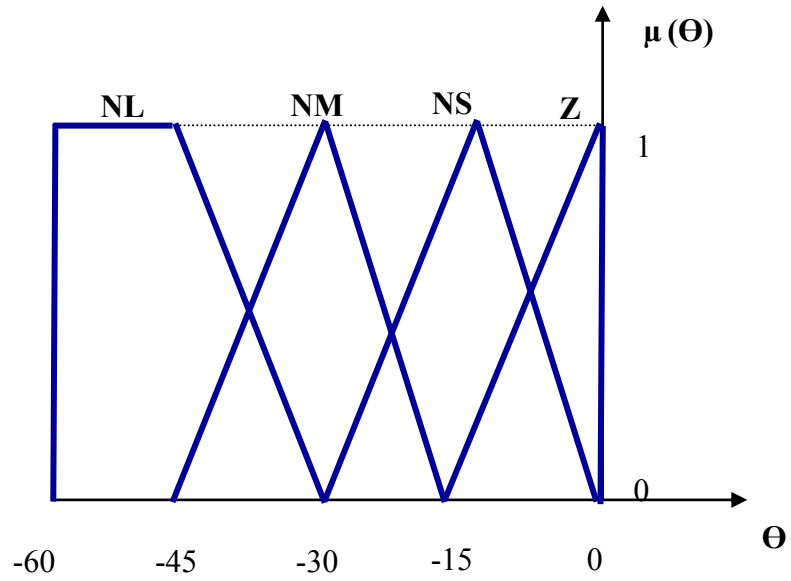
- 1- Using **MATLAB** program, open a new "fis" file and implement the following fuzzy controllers to land the plane safely with the following rules:

$\begin{matrix} \theta \\ h \end{matrix}$	NL	NM	NS	Z
Z	PL	PM	PS	Z
PS	PM	PS	Z	NS
PM	PS	Z	NS	NM
PL	Z	NS	NM	NL



The fuzzy sets of inputs and output of the controller are shown in the following figures:





(a) Find the controller crisp output and fuzzy form output in the following cases:

- $\theta(t) = -27^\circ$ and $h(t) = 100$ m.
- $\theta(t) = -43^\circ$ and $h(t) = 255$ m.
- $\theta(t) = -10^\circ$ and $h(t) = 450$ m.
- $\theta(t) = -35^\circ$ and $h(t) = 200$ m.
- $\theta(t) = -20^\circ$ and $h(t) = 4750$ m.

(b) View the surface of the fuzzy controller inputs and outputs.

2- Using the error signal (e) and the change of error (Δe), design a fuzzy-PD controller with the following specs:

- No. of fuzzy sets for the inputs (e and Δe) is 5.
- No. of fuzzy sets for the output (u) is 7.
- Use (NM , NS , Z , PS , PM) as the labels of the fuzzy sets inputs (e and Δe).
- Use (NL , NM , NS , Z , PS , PM , PL) as the labels of the fuzzy sets output (u).
- The universe of discourse :
 - $e \longrightarrow$ from -4 to 4
 - $\Delta e \longrightarrow$ from -1 to 1
 - $u \longrightarrow$ from -9 to 9

(a) Draw the fuzzy sets for the inputs and output of the fuzzy controller.

(b) Write the suitable rules and use **MATLAB** program to implement the designed controller.

(c) Find the controller crisp output and fuzzy form output in the following cases:

- $e = 3$ and $\Delta e = -0.5$
- $e = -2$ and $\Delta e = -0.2$
- $e = 2.6$ and $\Delta e = 0.35$

(d) View the surface of the fuzzy controller inputs and outputs.